

Serial No.: 10/628,318  
Docket No.: GMC 0047 PA/40320.52

### AMENDMENTS TO THE CLAIMS

1. (Currently amended) A device configured to convert a hydrogenous fuel source to electrical energy, said device comprising:

an electrochemical conversion assembly configured to partition said device into first and second flow field regions;

a first reactant input and a first product output in communication with said first flow field region;

a first diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said first flow field region and said electrochemical conversion assembly;

a second reactant input and a second product output in communication with said second flow field region; and

a second diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said second flow field region and said electrochemical conversion assembly, wherein

said device is configured such that at least one of said first and second diffusion media comprise a region subject to relatively high H<sub>2</sub>O concentrations and a region subject to relatively low H<sub>2</sub>O concentrations,

a mesoporous layer is carried along at least a portion of a major face of one of said first and second diffusion media substrates and comprises a hydrophilic carbonaceous component and a hydrophobic component, and

said mesoporous layer occupies a substantially greater portion of one of said high H<sub>2</sub>O region and said low H<sub>2</sub>O region relative to the other of said high H<sub>2</sub>O region and said low H<sub>2</sub>O region, wherein

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

said mesoporous layer is carried along a reduced thickness portion of at least one of said first and second diffusion media substrates and/or said mesoporous layer at least partially infiltrates at least one of said first and second diffusion media substrates;  
and

said hydrophilic carbonaceous component comprises a moderate surface area carbon characterized by mean particle size of between about 15 nm and about 70 nm in said high H<sub>2</sub>O regions.

2. (Original) A device as claimed in claim 1 wherein said mesoporous layer is substantially confined to one of said high H<sub>2</sub>O region and said low H<sub>2</sub>O region.
3. (Previously presented) A device as claimed in claim 1 wherein said mesoporous layer is configured to enhance H<sub>2</sub>O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer.
4. (Original) A device as claimed in claim 1 wherein said mesoporous layer occupies a substantially greater portion of said high H<sub>2</sub>O region.
5. (Previously presented) A device as claimed in claim 1 wherein said mesoporous layer occupies a substantially greater portion of said high H<sub>2</sub>O region and is configured to enhance H<sub>2</sub>O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer.
6. (Previously presented) A device as claimed in claim 1 wherein said mesoporous layer is configured to diminish H<sub>2</sub>O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer.

Serial No.: 10/628,318  
Docket No.: GMC 0047 PA/40320.52

7. (Original) A device as claimed in claim 6 wherein said mesoporous layer occupies a substantially greater portion of said low H<sub>2</sub>O region.

8. (Previously presented) A device as claimed in claim 1 wherein said mesoporous layer occupies a substantially greater portion of said low H<sub>2</sub>O region and is configured to diminish H<sub>2</sub>O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer.

9. (Original) A device as claimed in claim 1 wherein:

said electrochemical conversion assembly defines an anode side of said device and a cathode side of said device;

said first reactant input and said first product output are in communication with said anode side of said device;

said second reactant input and said second product output are in communication with said cathode side of said device.

10. (Previously presented) A device as claimed in claim 9 wherein:

said mesoporous layer is configured to enhance H<sub>2</sub>O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer;

said region subject to relatively high H<sub>2</sub>O concentrations is proximate said second product output in communication with said cathode side of said device; and

said mesoporous layer occupies a substantially greater portion of said high H<sub>2</sub>O region proximate said second product output.

11. (Previously presented) A device as claimed in claim 9 wherein:

said mesoporous layer is configured to enhance H<sub>2</sub>O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer;

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

said region subject to relatively high H<sub>2</sub>O concentrations is proximate said first reactant input in communication with said anode side of said device; and

said mesoporous layer occupies a substantially greater portion of said high H<sub>2</sub>O region proximate said first reactant input.

12. (Previously presented) A device as claimed in claim 9 wherein:

said mesoporous layer is configured to diminish H<sub>2</sub>O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer;

said region subject to relatively low H<sub>2</sub>O concentrations is proximate said second reactant input in communication with said cathode side of said device; and

said mesoporous layer occupies a substantially greater portion of said low H<sub>2</sub>O region proximate said second reactant input.

13. (Previously presented) A device as claimed in claim 9 wherein:

said mesoporous layer is configured to diminish H<sub>2</sub>O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer;

said region subject to relatively low H<sub>2</sub>O concentrations is proximate said first product output in communication with said anode side of said device; and

said mesoporous layer occupies a substantially greater portion of said low H<sub>2</sub>O region proximate said first product output.

14. (Original) A device as claimed in claim 1 wherein a plurality of said mesoporous layers are carried along respective portions of a major face of one of said first and second diffusion media substrates.

15. (Previously presented) A device as claimed in claim 14 wherein:

a mesoporous layer configured to enhance H<sub>2</sub>O transfer properties of at least one of said first and second diffusion media substrates occupies a substantially greater portion of said high H<sub>2</sub>O region; and

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

a mesoporous layer configured to diminish H<sub>2</sub>O transfer properties of said diffusion media substrate occupies a substantially greater portion of said low H<sub>2</sub>O region.

16. (Canceled)

17. (Currently amended) A device as claimed in claim ~~16~~ wherein a difference in thickness of said substrate introduced said reduced thickness portion of said substrate is sufficient to accommodate for an increase in diffusion media thickness introduced by said mesoporous layer.

18. (Previously presented) A device as claimed in claim 1 wherein said diffusion media substrates comprises a carbonaceous fibrous matrix.

19. (Original) A device as claimed in claim 1 wherein said hydrophobic component of said mesoporous layer comprises a fluorinated polymer.

20. (Original) A device as claimed in claim 1 wherein said hydrophilic carbonaceous component of said mesoporous layer is selected from carbon black, graphite, carbon fibers, carbon fullerenes, carbon nanotubes, and combinations thereof.

21. (Previously presented) A device as claimed in claim 1 wherein said moderate surface area carbon is characterized by a surface area of between about 60 m<sup>2</sup>/g and about 300 m<sup>2</sup>/g.

22. (Original) A device as claimed in claim 1 wherein said hydrophilic carbonaceous component comprises a high surface area carbon characterized by a surface area of above about 750 m<sup>2</sup>/g and a mean particle size of less than about 20 nm in said low H<sub>2</sub>O regions.

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

23. (Original) A device as claimed in claim 1 wherein said mesoporous layer comprises about 80 wt% of said carbonaceous component in said high H<sub>2</sub>O region.
24. (Original) A device as claimed in claim 1 wherein said mesoporous layer comprises between about 75 wt% and about 85 wt% of said carbonaceous component in said high H<sub>2</sub>O region.
25. (Original) A device as claimed in claim 1 wherein said mesoporous layer comprises between about 90 wt% and about 95 w% of said carbonaceous component in said low H<sub>2</sub>O region.
26. (Original) A device as claimed in claim 1 wherein said mesoporous layer defines a thickness of less than about 20μm in said high H<sub>2</sub>O regions.
27. (Original) A device as claimed in claim 1 wherein said mesoporous layer defines a thickness of between about 10μm and about 40μm in said low H<sub>2</sub>O regions.
28. (Canceled)
29. (Previously presented) A device as claimed in claim 1 wherein said mesoporous layer infiltrates at least one of said first and second diffusion media substrates to a depth of less than 10μm in said high H<sub>2</sub>O regions.
30. (Previously presented) A device as claimed in claim 1 wherein said mesoporous layer infiltrates at least one of said first and second diffusion media substrates to a depth of less than 25μm in said low H<sub>2</sub>O regions.

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

31. (Original) A device as claimed in claim 1 wherein said device comprises a fuel cell.
32. (Original) A device as claimed in claim 31 wherein said device further comprises structure defining a vehicle powered by said fuel cell.
33. (Currently amended) A device configured to convert a hydrogenous fuel source to electrical energy, said device comprising:
- an electrochemical conversion assembly configured to partition said device into first and second flow field regions;
  - a first reactant input and a first product output in communication with said first flow field region;
  - a first diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said first flow field region and said electrochemical conversion assembly;
  - a second reactant input and a second product output in communication with said second flow field region; and
  - a second diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said second flow field region and said electrochemical conversion assembly, wherein
    - said device is configured such that at least one of said first and second diffusion media comprise a region subject to relatively high H<sub>2</sub>O concentrations and a region subject to relatively low H<sub>2</sub>O concentrations,
    - a mesoporous layer is carried along at least a portion of a major face of one of said first and second diffusion media substrates and comprises a hydrophilic carbonaceous component and a hydrophobic component,
    - at least one of said first and second diffusion media substrates comprises a relatively high porosity region and a relatively low porosity region,

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

said relatively high porosity region of said substrate occupies a substantially greater portion of said high H<sub>2</sub>O region and said relatively low porosity region of said substrate occupies a substantially greater portion of said low H<sub>2</sub>O region, wherein

said mesoporous layer is carried along a reduced thickness portion of at least one of said first and second diffusion media substrates and/or said mesoporous layer at least partially infiltrates at least one of said first and second diffusion media substrates;  
and

said hydrophilic carbonaceous component comprises a moderate surface area carbon characterized by mean particle size of between about 15 nm and about 70 nm in said high H<sub>2</sub>O regions.

34. (Original) A device as claimed in claim 33 wherein said relatively high porosity region is characterized by a porosity of up to about 90%.
35. (Original) A device as claimed in claim 33 wherein said relatively low porosity region is characterized by a porosity of between about 70% and about 75%.
36. (Original) A device as claimed in claim 33 wherein said substrate is characterized by a porosity of above about 70% in said high H<sub>2</sub>O regions.
37. (Original) A device as claimed in claim 33 wherein said substrate is characterized by a porosity of between about 70% and about 75% in said low H<sub>2</sub>O regions.



Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

38. (Original) A device as claimed in claim 33 wherein said substrate defines a thickness of between about 100 $\mu$ m and about 300 $\mu$ m in said high H<sub>2</sub>O regions.

39. (Original) A device as claimed in claim 33 wherein said substrate defines a thickness of between about 190 $\mu$ m and about 300 $\mu$ m in said low H<sub>2</sub>O regions.

40. (Original) A device as claimed in claim 33 wherein said substrate is characterized by a mean pore size of above about 20 $\mu$ m in said high H<sub>2</sub>O regions.

41. (Original) A device as claimed in claim 33 wherein said substrate is characterized by a mean pore size of less than about 25 $\mu$ m in said low H<sub>2</sub>O regions.

42. (Original) A device configured to convert a hydrogenous fuel source to electrical energy, said device comprising:

- an electrochemical conversion assembly configured to partition said device into first and second flow field regions;

- a first reactant input and a first product output in communication with said first flow field region;

- a first diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said first flow field region and said electrochemical conversion assembly;

- a second reactant input and a second product output in communication with said second flow field region; and

- a second diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said second flow field region and said electrochemical conversion assembly, wherein

- said device is configured such that at least one of said first and second diffusion media comprise a region subject to relatively high H<sub>2</sub>O concentrations and a region subject to relatively low H<sub>2</sub>O concentrations,

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

a mesoporous layer is carried along at least a portion of a major face of one of said first and second diffusion media substrates and comprises a hydrophilic carbonaceous component and a hydrophobic component,

said mesoporous layer occupies substantial portions of said high H<sub>2</sub>O region and said low H<sub>2</sub>O region,

said mesoporous layer comprises a region of increased porosity relative to a remaining portion of said mesoporous layer,

said region of increased porosity of said mesoporous layer occupies a substantially greater portion of said high H<sub>2</sub>O region relative to said low H<sub>2</sub>O region, and

said remaining portion of said mesoporous layer occupies a substantially greater portion of said low H<sub>2</sub>O region relative to said high H<sub>2</sub>O region.

43. (Original) A device as claimed in claim 42 wherein said region of increased porosity of said mesoporous layer is defined by a plurality of megapores characterized by a pore size of between about 100µm and about 500µm.

44. (Previously presented) A device configured to convert a hydrogenous fuel source to electrical energy, said device comprising;

an electrochemical conversion assembly configured to partition said device into first and second flow field regions;

a first reactant input and a first product output in communication with said first flow field region;

a first diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said first flow field region and said electrochemical conversion assembly;

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

a second reactant input and a second product output in communication with said second flow field region; and

a second diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said second flow field region and said electrochemical conversion assembly, wherein

said device is configured such that at least one of said first and second diffusion media comprise a region subject to relatively high H<sub>2</sub>O concentrations and a region subject to relatively low H<sub>2</sub>O concentrations,

a mesoporous layer is carried along at least a portion of a major face of one of said first and second diffusion media substrates and comprises a hydrophilic carbonaceous component and a hydrophobic component, said mesoporous layer at least partially infiltrating at least one of said first and second diffusion media substrates, and

said mesoporous layer occupies a substantially greater portion of one of said high H<sub>2</sub>O region and said low H<sub>2</sub>O region relative to the other of said high H<sub>2</sub>O region and said low H<sub>2</sub>O region.

45. (Previously presented) A device configured to convert a hydrogenous fuel source to electrical energy, said device comprising:

an electrochemical conversion assembly configured to partition said device into first and second flow field regions;

a first reactant input and a first product output in communication with said first flow field region;

a first diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said first flow field region and said electrochemical conversion assembly;

Serial No.: 10/628,318  
Docket No.: GMC 0047 PA/40320.52

a second reactant input and a second product output in communication with said second flow field region; and

a second diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said second flow field region and said electrochemical conversion assembly, wherein

said device is configured such that at least one of said first and second diffusion media comprise a region subject to relatively high H<sub>2</sub>O concentrations and a region subject to relatively low H<sub>2</sub>O concentrations,

a mesoporous layer is carried along at least a portion of a major face of one of said first and second diffusion media substrates and comprises a hydrophilic carbonaceous component and a hydrophobic component, said mesoporous layer at least partially infiltrating at least one of said first and second diffusion media substrates, and

at least one of said first and second diffusion media substrates comprises a relatively high porosity region and a relatively low porosity region,

said relatively high porosity region of said substrate occupies a substantially greater portion of said high H<sub>2</sub>O region and said relatively low porosity region of said substrate occupies a substantially greater portion of said low H<sub>2</sub>O region